United States
Department of
Agriculture

Animal and
Plant Health
Inspection Service

Plant Protection
and Quarantine

Program Aid
Number 1472

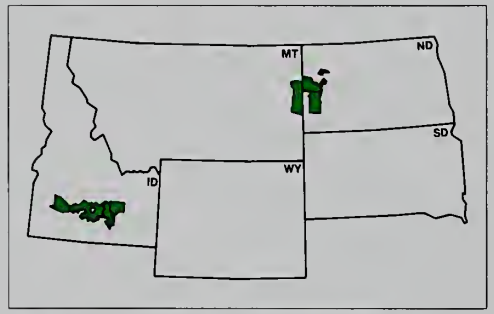
Grasshopper

Integrated Pest Management

Introduction

Rangeland grasshoppers and Mormon crickets appear each year across America and often cause serious forage losses in the Western States and parts of Alaska. As recently as 1985, for example, widespread grasshopper infestations on 55 million acres of America's western rangeland and farms caused the most crop and forage damage since major outbreaks in the late 1930's.

This problem is of great concern both to ranchers whose livestock must compete with these insects for forage and to Government personnel who are responsible for decisions regarding grazing management and insect control on Federal lands.



The Grasshopper IPM Project involves the Western United States, where migratory grasshoppers cause serious forage losses to rangelands and farms.

Grasshoppers live in a multitude of habitats—grasslands, meadows, and fields. These pests feed on forbs, grasses, alfalfa, and small grains.

In response to the economic losses incurred by ranchers and farmers in the 1985 outbreaks, the U.S. Department of Agriculture (USDA) initiated a pilot project on grasshopper integrated pest management to study grasshopper populations and how to control them.

The Program

The Grasshopper Integrated Pest Management (GHIPM) Project began in 1987 as a 5-year pilot program. It was designed to examine the effectiveness of integrated pest management (IPM) strategies in controlling grasshopper infestations and to provide the results of the study to managers of public and private lands.

The primary focus of the project is to

- Develop the means to predict and manage grasshopper outbreaks,
- Develop alternative grasshopper control techniques, and
- Integrate proven control techniques into guidelines for future control programs.

USDA historical photo, circa 1930.

Throughout the history of American agriculture, grasshoppers have plagued farmers and ranchers. This farmer is collecting grasshoppers from his field to use for animal feed.

Historical photo, Montana State University, circa 1917.

In order to accomplish this, the project oversees research to

- Manage grasshopper population densities in demonstration areas,
- Develop new management strategies for rangeland grasshoppers and Mormon crickets, and
- Provide these strategies to public and private land managers.

Cooperation

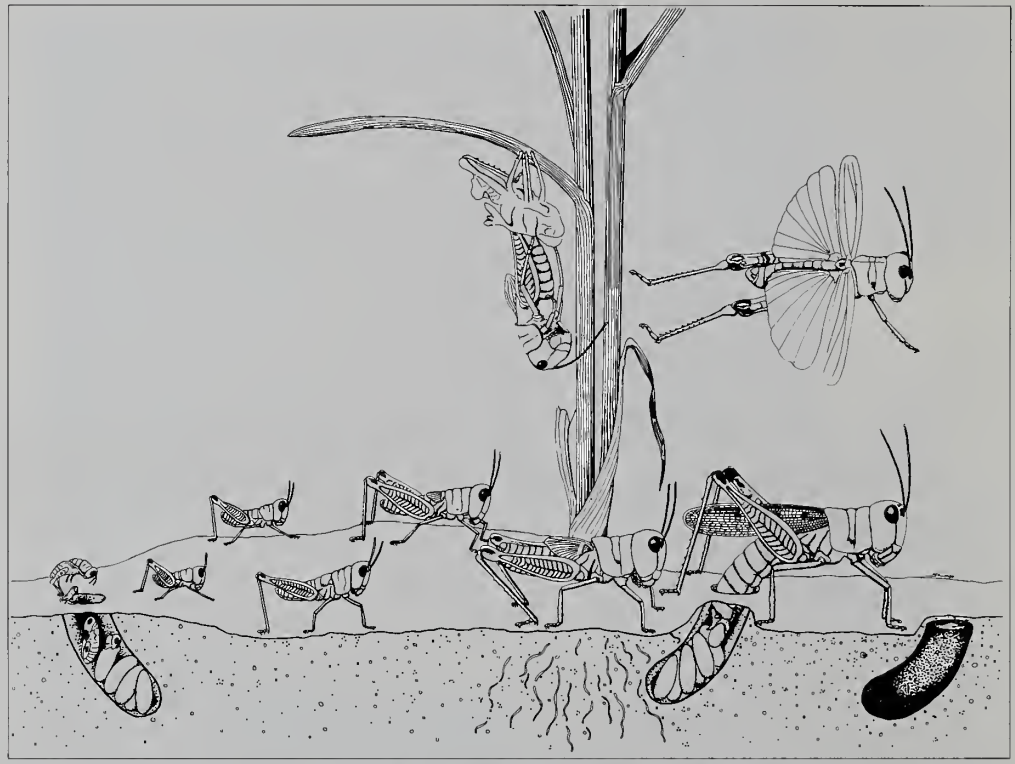
The GHIPM Project is a cooperative effort managed by USDA's Animal and Plant Health Inspection Service (APHIS). The other Federal agencies participating in the project include

U.S. Department of Agriculture
- Agricultural Research Service
- Economic Research Service
- Forest Service
- Extension Service

U.S. Department of the Interior
- Bureau of Land Management
- Fish and Wildlife Service
- National Park Service

U.S. Environmental Protection Agency
- Office of Pesticide Programs

In addition, nine universities, numerous scientists and technicians, and various public interest groups work with the project to evaluate current grasshopper management techniques and develop improved methods to suppress these pests.



Life cycle: In the spring, grasshoppers hatch and develop through five molts before becoming winged adults (30–40 days). In late summer, adult females deposit eggs into the soil for overwintering. A new generation emerges the following spring.

An Integrated Approach

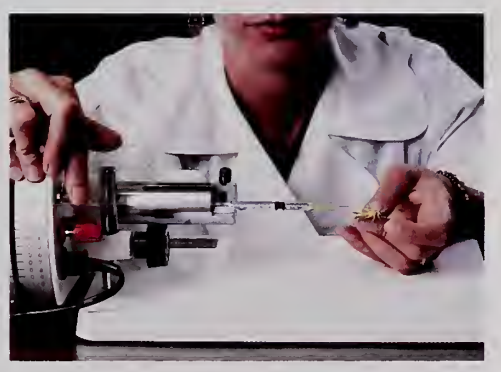
IPM is the use of management practices to keep pest populations below levels that cause economic damage. IPM uses a compatible balance of biological, cultural, chemical, and genetic control methods. Controls can be aimed at one or more pests depending upon the scope of infestations and the complexity of each situation.

The IPM concept comes from the realization that any disruption of a pest population will affect other pests and also beneficial organisms in the ecosystem. Decisionmakers who choose IPM are attempting to manage pests, not eradicate them.

An integrated grasshopper management approach can help land managers predict when environmental conditions are conducive to grasshopper population explosions. Armed with this knowledge, managers can then use IPM techniques to keep grasshopper populations at levels where they do not cause economically unacceptable damage.

◀ GHIPM Project technicians raise thousands of grasshoppers in laboratory rearing chambers for scientific and behavioral research.

A technician with USDA's Agricultural Research Service examines grasshoppers infected with species-specific viruses. USDA hopes to integrate biological control technology into future grasshopper management schemes. ▼



Operations

The GHIPM Project is headquartered in Boise, ID. Fieldwork is accomplished at rangeland areas in McKenzie County, ND, and the Shoshone Bureau of Land Management District in southern Idaho. These rangelands represent major western ecosystems in which grasshopper outbreaks usually occur. The two fieldwork sites each contain a no-treatment area, a standard treatment area, and a demonstration area.

No-Treatment Areas

In these areas, neither APHIS, the GHIPM Project, nor any other cooperator funds or participates in any program to control grasshoppers or Mormon crickets. The no-treatment alternative enables the GHIPM Project to study the impact of allowing grasshopper populations to develop without intervention. These control areas provide a benchmark against which other alternatives can be evaluated.

Standard Treatment Areas

Within these areas, APHIS guidelines govern the management of grasshopper infestations. Typically, APHIS implements biological or chemical control methods when grasshopper populations approach eight insects per square yard. At this level, grasshopper activity usually becomes economically important—destroying significant amounts of forage for livestock. Treatment decisions also hinge on other local factors, such as grasshopper and plant species, grasshopper life stage, and range condition.

Chemicals effective against grasshoppers include Orthene, Sevin 4-Oil, malathion, and a bait prepared with wheat bran and carbaryl. These materials have been approved for use on rangeland by the Environmental Protection Agency because of low toxicity to birds, mammals, and the environment.

The current biological control agent for grasshoppers is *Nosema locustae,* a naturally occurring protozoan that parasitizes many species of grasshoppers, including Mormon crickets. Formulateed in a bran mixture, *N. locustae* does not affect other species of insects, such as honey bees.

Liquid pesticides are usually applied aerially at ultralow volume. Bran baits can be applied by either ground or aerial equipment.

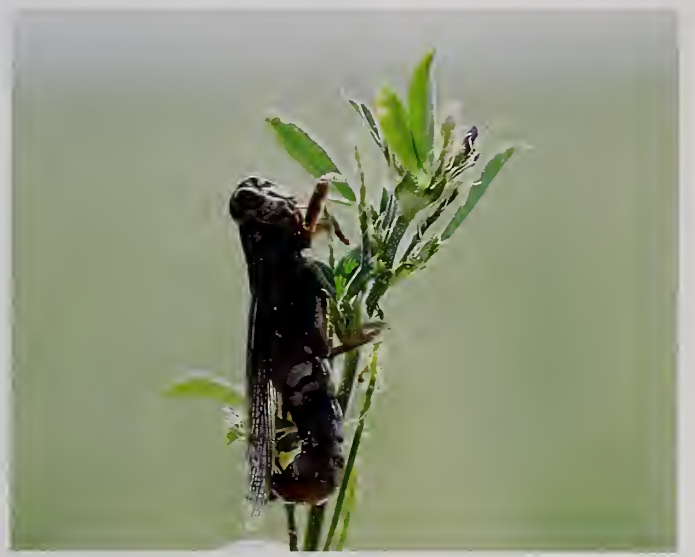
Demonstration Areas

The GHIPM Project tests IPM strategies in selected demonstration areas. Based on future grasshopper management needs, these strategies will help identify and evaluate new control options.

Research and implementation activities include

- Formulation of selective grasshopper bran baits;
- Testing of pathogens, such as fungi, viruses, and protozoa, for biological control of grasshoppers;
- Improvement of range management techniques;
- Monitoring of environmental effects of pesticide;
- Evaluation of posttreatment effectiveness and range management practices; and
- Collection of data for development of predictive modeling.

Each of the 40 GHIPM Project data-gathering sites has weather-monitoring units. The data are integrated into models that predict grasshopper populations.



Fungal pathogens infect grasshoppers directly through their outer covering. Fungus killed this grasshopper, leaving a cadaver to release thousands of spores to infect other grasshoppers.

Surveys

Three official surveys are conducted each year within the project study areas: nymphal, delimiting, and adult. These surveys determine the location, density, age, and species of grasshoppers present in the plots.

Nymphal Survey

This survey, beginning in the spring and continuing into early summer, is a continuous observation of young and hatching grasshoppers. It is aimed at determining the need for a control program in a particular test area. Nymphal surveys concentrate on those areas identified during the previous year's adult survey as having potential for economically significant infestations.

Project personnel count the number of nymphs present, assess egg hatching, and calculate naturally occurring mortality rates. They also survey for grasshopper pathogens and other natural control agents. The condition of the rangeland in relation to grasshopper numbers is also assessed.

GHIPM Project technicians collect grasshoppers from the range and transport them to the laboratory for research.

Delimiting Survey

When the nymphal survey or reports from GHIPM Project participants identify problem areas, a delimiting survey is conducted to establish infestation boundaries. Procedures for estimating populations are the same as in nymphal and adult surveys, but sampling is limited to the area where control programs might be needed. Sensitive locations (e.g., streams, apiaries, and wetlands) are noted for future reference in planning control efforts.

Adult Survey

A survey of adult grasshoppers is conducted in late summer or early fall. For each study area, this survey provides information concerning grasshopper concentrations, natural predator and parasite populations, grasshopper species statistics, and rangeland damage evaluations. This information is classed and recorded to produce a yearly outlook map to help forecast the next year's grasshopper populations.

GHIPM Project technicians survey study areas each year for density, age, and species of grasshoppers. These data are used to forecast next year's grasshopper populations.

Project-Supported Research

The GHIPM Project provides research grants to universities and other cooperators to develop and evaluate grasshopper management methods that could lead to new control tools. Four classes of studies have been established.

Forecast Studies

These studies are conducted to help predict the time of year when grasshopper outbreaks will occur, the age structure of grasshopper populations during outbreaks, and changes in grasshopper density. Studies cover such topics as range management, grasshopper biology, and the relationship of egg production to soil and water concentrations.

Survey Studies

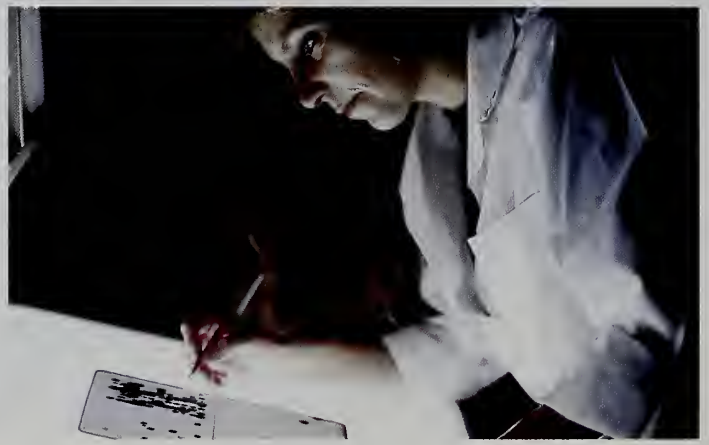
These studies are conducted to improve the accuracy of field surveys. Research results help establish accurate field guides to assist survey personnel in identifying nymph and adult grasshoppers. The field guides portray economically significant grasshopper species, including information on their distribution and habitat, plant preference, and phenology.

Decisionmaking Studies

This research component looks at costs and benefits along with environmental impacts of grasshopper control. Decisionmaking research includes studies on treatment efficacy, economic analysis of grasshopper management strategies, total forage yield, relationships between grasshopper density and forage loss, and pollinators of threatened and endangered plants, as well as extensive monitoring of the environmental impacts of control programs.

Options Studies

These studies are designed to evaluate current treatments and to develop new control strategies. Research on new chemical compounds and methods of application are included along with concerted efforts to discover new biological control agents (viruses, fungi, protozoa, and parasites).



GHIPM Project scientists hope to enhance pathogen research through DNA technology. They are developing a DNA probe to detect viruses in tissue samples.

Application of Operational Research

Range management has evolved into a complex business requiring the accumulation and integration of knowledge from a variety of sources, including insect management studies, control programs, and range condition assessments. But range managers rarely have all the necessary information available to make good management decisions. With this fact in mind, the GHIPM Project has developed a computer-based decision support system, called HOPPER.

HOPPER is a user-friendly software package that integrates the information gleaned from the various components of the GHIPM Project. HOPPER provides information that facilitates grasshopper predictions, timing and selection of control options, compilation of weather data, and analysis of the economics of range management practices. The program can be run on a standard IBM personal computer or clone.

HOPPER will enable range managers and farmers to evaluate their grasshopper management options more easily while maximizing environmental protection and the economic benefits of control.

Rangeland management can be improved through effective control of grasshopper populations.

To obtain a free copy of HOPPER, send a blank disk (5-1/4-inch or 3-1/2-inch) to:

USDA-APHIS
Grasshopper IPM Project
Public Affairs
3380 Americana Terrace, Suite No. 340
Boise, ID 83706.

Note: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your county agriculture agent or State extension specialist to be sure the intended use is still registered.

Cover photo: The migratory grasshopper, *Melanoplus sanguinipes,* has a great capacity for population increase, particularly in periods of drought and low incidence of disease, parasites, and predators.

Illustration, page 4: courtesy of Robert E. Pfadt, University of Wyoming, Laramie.

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